CHINI - PLS CHECK

MEMORANDUM

A-11176

REFER		NOTED	
TO	DATE	BY	DATE
RETURN TO		FILE	

Herbert A. Tessler, Supervisor, Functional Coordination

FROM: Irv Soffer

DATE: May 13, 1966

SUBJECT: WTC - TOWERS - EXTERIOR WALL DESIGN

REFERENCE:

COPY TO: P. Di Paolo, D. Dreiss (JBB), L. Feld, J. Zudler (Tishman), I. Gershon (ERS), M. Levy, E. D. Mills, L. Robertson (WSHJ), A. Schreier (MYA), E. Tuschiya (MYA) C. Panero, J. Solomon (ERS)

Attached is a chart of "Thermal Conductivity and Heat Transmission" that I prepared from the data supplied to me by Mr. Zeitlin and Mr. Trechsel of the U. S. Steel Co. Applied Research Laboratory in Monroeville, Pa. (Pittsburgh).

The values of the material will vary slightly dependent on the manufacturer. However, the chart clearly indicates the relative range of values, based on the present WTC Tower wall material design.

192-49

Irv Soffer

IS:dd
att.

PA LAW DEPARTMENT
58900

WORLD TRAD[illegible] R

3/8" URETHANE
NO AIR SPACE

WITH 1 5/8" F.P. & AIR SPACE

1 5/8 F.P. + 3/8" URETHANE

EXTERIOR WALL, SPANDRELS AND EXTERIOR COLUMN INSULATIONS

THERMAL CONDUCTIVITY AND HEAT TRANSMISSION COEFFICIENTS

Value Based on Wall & Column Design As of 5/5/66
Drawing A-A-314

Fireproofing Material	Conductivity (k) BTU / HR-SF-°F-IN	"U" - Coefficient Transmission - BTU/HR-SF-°F At Sides of Column: With 1 5/8" F.P.	At Sides of Column: With 3/8" Polyurethane Included	At Outside Face of Column (w Air Space): With 1 5/8" F.P.	At Outside Face of Column (w Air Space): With 3/8" Polyurethane Included	At Outside Face of Column (w Air Space): With 2" F.P. and 3/8" Polyurethane
1. Sprayed Mineral Fiber (Spraycraft)	.26	0.135 ~~.151~~	0.116 ~~.127~~	.136	.104	.092
2. Sprayed (Cementitious) Vermiculite (Monokote)	.75	0.302 ~~.429~~	.221	.302	.182	0.167 ~~.192~~
3. Plasterated Gypsum Board (U. S. G. Fire Code)	1.11	0.385 ~~.595~~	.261	.385	.209	.195
4. Concrete (L.W. 100 PCF)	3.57	0.630 ~~1.62~~	.353	.625	.264	.256
5. [illegible]	.38	0.185 ~~.227~~	.151	.185	.131	0.116 ~~.127~~
6. Cafco	.27	0.140 ~~.162~~	.119	.140	0.107 ~~.100~~	0.093 ~~.094~~

Notes:

1. Fireproofing for inside face of column is assumed to be 1 3/8" gypsum plaster having conductivity of 1.56 and the c all transmission coeff. of .396 between the room and column steel.
2. Inside still air film resistance is taken as .68
3. Outside air film resistance is taken as .17
4. Air space resistance is taken as .97
5. Conductivity of polyurethane is taken as .17

NC:rt,dd

PRELIMINARY STUDY

192-65

WORLD TRADE CENTER

EXTERIOR WALL, SPANDRELS AND EXTERIOR COLUMN INSULATIONS

THERMAL CONDUCTIVITY AND HEAT TRANSMISSION COEFFICIENTS

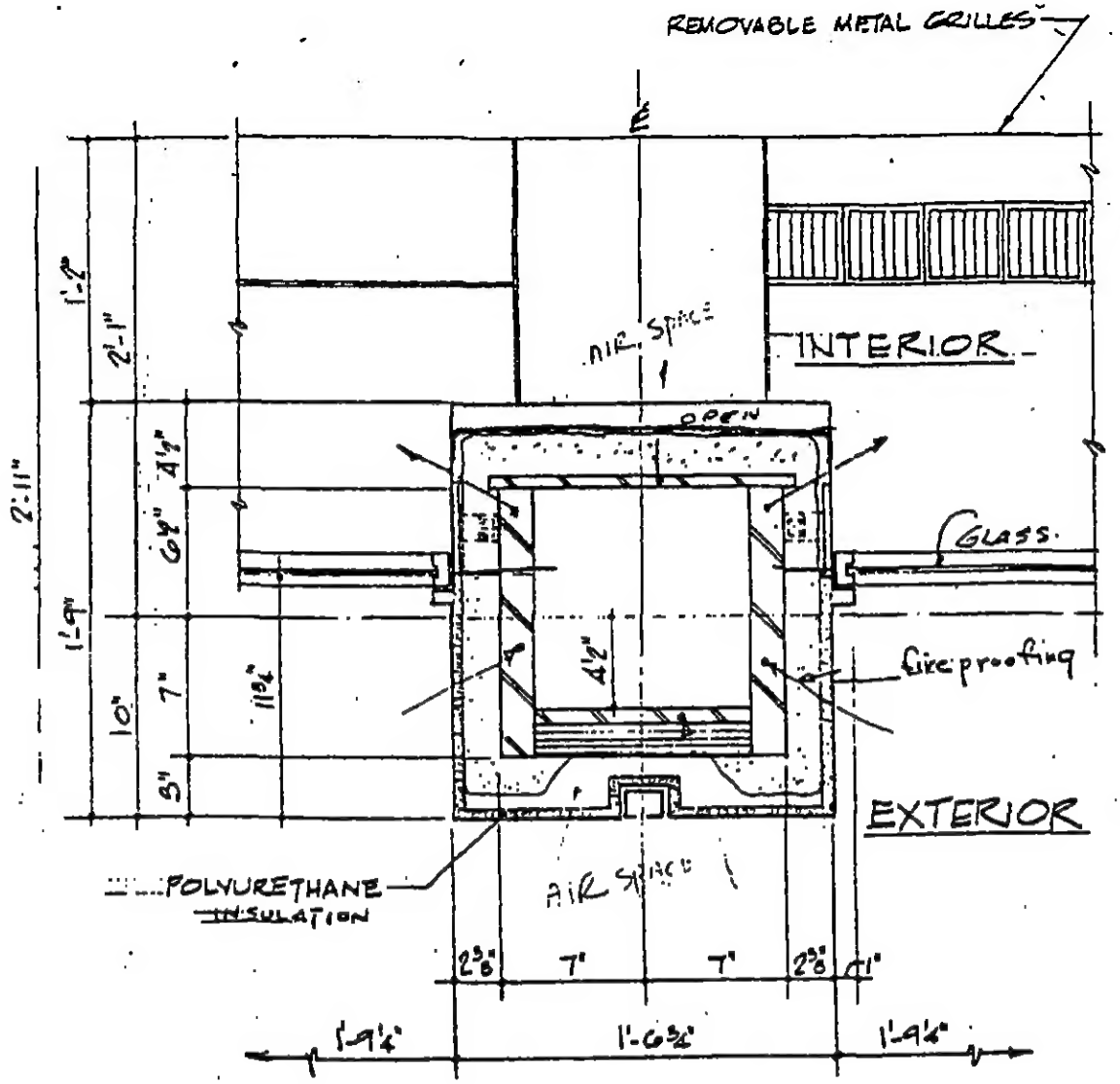
Value Based on Wall & Column Design As of 5/5/66
Drawing A-A-314

Fireproofing Material	Conductivity (k) BTU / HR-SF-8F-IN	"U" - Coefficient Transmission - BTU/HR-SF-OF				
		At Sides of Column		At Outside Face of Column (W/Air Space)		
		With 1 5/8" F. P.& Air Space	1 5/8" F. P.+ 3/8" Urethane No Air Space	With 1 5/8" F. P.	1 5/8" F. P.+ 3/8" Urethane	With 2" F.P. and 3/8" Polyurethane
1. Sprayed Mineral Fiber (Spraycraft)	.26	0.135	0.116	.136	.104	.092
2. Sprayed (Cementitious) Vermiculite (Monokote)	.75	0.302	.221	.302	.182	0 .167
3. Laminated Gypsum Board (U.S.G. FireCode)	1.11	0.385	.261	.385	.209	.195
4. Concrete (L.W. 100 PCF)	3.57	0.630	.353	.625	.264	.256
5. Vonco	.38	0.185	.151	.185	.131	0.116
6. Cafco	.27	0.140	.119	.140	0.107	0.093

Notes:

1. Fireproofing for inside face of column is assumed to be 1 3/8" gupsum plaster having conductivity of 1.56 and the overall transmission coeff. of .396 between the room and column steel.
2. Inside still air film resistance is taken as .68
3. Outside air film resistance is taken as .17
4. Air space resistance is taken as .97
5. Conductivity of polyurethane is taken as .17

NC:rt,dd,fk



192-69

EXTERIOR WALL COLUMN

TOWERS A & B

SCALE 12"=1'-0"
DRAWN BY S.Z.
APPROVED

THE PORT OF NEW YORK AUTHORITY
THE WORLD TRADE CENTER

DATE PROJECT NO DRAWING M-A-72

Spacecraft.

.17 air film
.97 air space
6.25 1 5/8" F.P.
7.39 = R $u = \frac{1}{R} = .135$

.97 air space
6.42
2.2
8.62 $u = \frac{1}{8.62} = .116$

2. 1.14
2.17
3.31 u = .302
− .97
2.34
2.2
4.54 u = .221

3.31
2.2
.5
6.01

3. 1.14
1.46
2.60 u = .385

192.49

4. 1.14
.45
1.595 u = .63
.97
.625
2.2
2.825 u = .353

5. 1.14
4.27
5.41 u = .185

5.41
2.2
.986
8.596

1.14
.14

9.35
1.34

WORLD TRADE CENTER

EXTERIOR WALL, SPANDRELS AND EXTERIOR COLUMN INSULATIONS

THERMAL CONDUCTIVITY AND HEAT TRANSMISSION COEFFICIENTS

Value Based on Wall & Column Design Shown on SK M-A-72 (June 23, 1966)

Fireproofing Material	Conductivity (k) BTU / HR-SF-PER-IN.	R	"U" - Coefficient Transmission - BTU/HR-SF-°F At Sides of Column: With 1 5/8" F.P.	At Sides of Column: With 3/8" Polyurethane Included	At Outside Face of Column (W/Air Space): With 1 5/8" F.P.	At Outside Face of Column (W/Air Space): With 3/8" Polyurethane Included	At Outside Face of Column (W/Air Space): With 2" F.P. and 3/8" Polyurethane
1. Sprayed Mineral Fiber (Spraycraft)	.26	3.8	~~.135~~ .151	~~.116~~ .129	.136	.104	.092
2. Sprayed (Cementitious) Vermiculite (Monokote)	.75	1.33	~~.302~~ .329	.221	.302	.182	.152
3. Laminated Gypsum Board (U. S. G. Fire Code)	1.11	.9	~~.345~~ .595	.267	.383	.209	.195
4. Concrete (L.W. 100 PCF)	3.57	.28	~~1.62~~ 1.62	.353	.625	.264	.256
5. Vonco	.38	2.63	~~.190~~ .225	.151	.185	.131	.127
6. Cafco	.27	3.7	~~.14~~ .162	.119	.140	.106	.094

Notes:

1. Fireproofing for inside face of column is assumed to be 1 3/8" gypsum plaster having conductivity of 1.56 and the all transmission coeff. of .396 between the room and column steel.
2. Inside still air film resistance is taken as .68
3. Outside air film resistance is taken as .17
4. Air space resistance is taken as .97
5. Conductivity of polyurethane is taken as .17

NC:rc,dd

WTC - EXTERIOR WALL INSULATIONS

SPANDRELS AND EXTERIOR COLUMNS

THERMAL CONDUCTIVITY AND HEAT TRANSMISSION coefficients
~~(In Order of Max. Thermal Reduction)~~

VALUES BASED ON WALL & COLUMN DESIGN
As of May 5, 1966

	MATERIAL	CONDUCTIVITY (k) BTU/HR-SF-°F-IN ~~(Reciprocal of Resistivity)~~	RESISTANCE (R) HR-SF-°F-IN ~~(Conductance)~~	"U" - COEFF. TRANSMISSION - BTU/HR-SF-°F ~~Thermal Reduction Value~~ At Sides of Column: With 1-5/8" F.P.	At Sides of Column: With 3/8" Polyurethane Included	At Outside Face of Column (w/Air Sp: With 1-5/8" F.P.	At Outside Face of Column (w/Air Sp: With 3/8" Polyurethane Incl.	At Outside Face of Column (w/Air Sp: With 2" F.P. and 3/8" Polyurethane
1.	Sprayed Mineral Fibre (Spraycraft) ~~or Safco~~	~~0.04~~ .26	~~0.24~~ 3.85	~~0.25~~ .141	~~0.20~~ .107	~~0.19~~ .124	~~0.16~~ .097	~~0.14~~ .086
2.	Sprayed (Cementitious) Vermiculite (Monokote)	~~0.083~~ .25	~~0.36~~ 1.33	~~0.27~~ .332	~~0.20~~ .192	~~0.24~~ .125	~~0.20~~ .162	~~0.18~~ .138
3.	Laminated Gypsum Board (U. S. G. Fire Code)	~~0.125~~ 1.11	~~0.90~~ 9	~~0.39~~ .133	~~0.39~~ .222	~~0.40~~ .205	~~0.27~~ .172	~~0.25~~ .172
4.	Concrete (L.W. 100 PCF)	~~0.30~~ 3.33	~~3.60~~ .28	~~1.37~~ .767	~~0.41~~ .285	~~0.50~~ .44	~~0.30~~ .224	~~0.29~~ .218
5.	Gypsum Plaster	~~0.50~~ 1.56	~~2.00~~ .64	~~2.05~~	0 3/8"	0.60	0.32 Plaster Inside	0.31 U = .312
5		.32	3.1	.195	.137	.164	.112	.102
6		.27	3.7	.146	.11	.128	.097	.088
7.	Polyurethane	.17	5.88					

WTC - EXTERIOR WALL INSULATION

SPANDRELS AND EXTERIOR COLUMNS

THERMAL CONDUCTIVITY AND HEAT TRANSMISSION
(In Order of Max. Thermal Reduction)

VALUES BASED ON WALL & COLUMN DESIGN
As of May 5, 1966
(Drawings A-2-203)

MATERIAL	(Resistivity) "K"	(Conductance) "C"	"U" - Thermal Reduction Value				
			At Sides of Column		At Outside Face of Column (w/Air Spa		
			With 1-5/8" F.P.	With 3/8" Polyurethane Included	With 1-5/8" F.P.	With 3/8" Polyurethane Incl.	With 2" F.P. and 3/8" Polyurethane
Sprayed Mineral Fibre (Spraycraft or Cafco)	0.04	0.24	0.23	0.20	0.19	0.16	0.14
Sprayed (Cementitious) Vermiculite (Monokote)	0.06	0.36	0.34	0.26	0.24	0.20	0.18
Laminated Gypsum Board (U. S. G. Fire Code)	0.15	0.90	0.79	0.39	0.46	0.27	0.25
Concrete (L.W. 100 PCF)	0.30	1.80	1.37	0.41	0.53	0.30	0.29
Gypsum Plaster	0.50	3.00	2.05	0.51	0.60	0.32	0.31